CLAIMS

What is claimed is:

1. A pump module for optical amplification of a light signal on a fiber-optic cable in a fiber-optic network, the pump module comprising:

an active component part comprising at least a first laser diode and a second laser diode disposed on a substrate, wherein the first laser diode outputs a first pumping beam and the second laser diode outputs a second pumping beam; and

a combiner disposed on the substrate and optically coupled to the active component part, wherein the combiner combines the first pumping beam and the second pumping beam into an output beam and wherein the combiner isolates the first laser diode and the second laser diode from back reflections.

2. The pump module set forth in claim 1, the active part being monolithically formed on the substrate.

3. The pump module set forth in claim 1, the active part comprising discrete laser diodes bonded to the substrate.

4. The pump module set forth in claim 3, the active part being bonded with epoxy to the substrate.

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5. The pump module set forth in claim 1, further comprising a first wave plate and a second wave plate, wherein the first wave plate linearly polarizes the first pumping beam and the second wave plate linearly polarizes the second pumping beam such that a state of polarization of the first pumping beam is substantially perpendicular to a state of polarization of the second pumping beam.

6. The pump module set forth in claim 1, wherein the first laser diode outputs a linearly polarized first pumping beam and wherein the second laser diode outputs a linearly polarized second pumping beam that is substantially perpendicular to the first pumping beam.

7. The pump module set forth in claim 1, wherein the active part is coupled to the combiner through free space.

8. The pump module set forth in claim 1, the active part coupled to the combiner through at least one fiber-optic pigtail.

9. The pump module set forth in claim 8, the first laser diode coupled to the combiner through a first polarization maintaining (PM) fiber and the second laser diode coupled to the combiner through a second PM fiber, the first PM fiber and the second PM fiber being arranged such that a slow optical axis of the first PM fiber is substantially perpendicular to a slow optical axis of the second PM fiber.

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10. The pump module set forth in claim 1 wherein the combiner comprises:

a first wedge;

a faraday rotator optically coupled to the first wedge;

a second wedge optically coupled to the faraday rotator; and

wherein the first wedge, second wedge, and faraday rotator are arranged such that the active component is optically isolated.

11. The pump module set forth in claim 10 wherein the Faraday rotator comprises a non-latching magnetic material.

12. The pump module set forth in claim 10 wherein the Faraday rotator comprises a latching magnetic material.

13. The pump module set forth in claim 10 wherein the first and second wedges are one or more of Wollaston, Rochon, Glan-Thomson and Glan-Taylor prisms.

14. The pump module set forth in claim 10 wherein the first and second wedges are thin film cubes.

15. The pump module set forth in claim 1, the active part further comprising, a plurality of photo diodes configured to monitor the output power of the plurality of laser diodes.

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16. A combiner for use in combining a first pumping beam with a second pumping beam traveling in a forward direction, the combiner comprising:

a first birefringent wedge that receives a first pumping beam and a second pumping beam, wherein a state of polarization of the first pumping beam is substantially perpendicular to a state of polarization of the second pumping beam;

a rotator that rotates the first pumping beam and the second pumping beam, wherein a return optical beam traveling in a backward direction through the combiner is rotated by the rotator such that a source of the first pumping beam and a source of the second beam are substantially isolated from the return optical beam ; and

a second birefringent wedge that combines the first pumping beam and the second pumping beam received from the rotator into an output beam.

17. A combiner as defined in claim 16, further comprising a first lens that focuses the first pumping beam and the second pumping beam into the first birefringent wedge.

18. A combiner as defined in claim 16, further comprising a second lens that focuses the output beam.

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19. A combiner as defined in claim 16, further comprising:

a first polarization maintaining fiber that is connected with a source of the first pumping beam; and

a second polarization maintaining fiber that is connected with a source of the second pumping beam.

20. A combiner as defined in claim 19, wherein a slow axis of the first polarization maintaining fiber is substantially perpendicular to a slow axis of the second polarization maintaining fiber.

21. A combiner as defined in claim 16, further comprising a latching magnetic material that protects the combiner from stray magnetic fields.

22. A combiner as defined in claim 16, further comprising a first laser diode that generates the first pumping beam and a second laser diode that generates the second pumping beam.

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23. A pump module for pumping an optical amplifier with pumping beams having different wavelengths, the pump module comprising:

a plurality of combiners, wherein each combiner receives a first beam having a first state of polarization and a first wavelength and a second beam having the first wavelength and a second state of polarization that is substantially orthogonal to the first state of polarization, wherein each combiner further comprises:

a first birefringent wedge that receives the first beam and the second beam;

a second birefringent wedge that combines the first beam and the second beam into an output beam; and

a Faraday rotator between the first birefringent wedge and the second birefringent wedge, wherein each combiner isolates a source of the first beam and a source of the second beam from back reflections.

24. A pump module as defined in claim 23, wherein the Faraday rotator rotates the back reflections such the first wedge directs the back reflections away from source of the first beam and away from a source of the second beam.

25. A pump module as defined in claim 23, wherein each of the plurality of the combiners receives a different wavelength.

26. A pump module as defined in claim 23, further comprising a plurality of laser diodes that generates each first beam and each second beam.

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27. A pump module as defined in claim 23, wherein each combiner generates an output beam used to amplify an optical signal.

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